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Complete Specification  
entitled (54) IMPROVEMENTS IN AND RELATING TO FOOTWEAR AND  
ITS MANUFACTURE

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The following statement is a full description of this invention, including the best method of performing it known to us :

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THIS INVENTION relates to footwear, such as shoes, boots and the like having uppers to which soles containing mouldable elastomers are moulded and bonded directly in moulds comprising a mould last and the components of a mould cavity.

According to the invention there is provided a method of manufacturing footwear such as boots and shoes comprising the steps of:

- a) providing an upper with a lasting string and a welt strip at its bottom margin,
- b) placing said upper onto a mould last and tightening said upper thereon to last the upper thereto,
- c) placing the lip of a side frame of the mould against the lasted upper and locking the side frame in that position,
- d) moving the upper and a sole moulding cavity means into juxtaposition to close the sole moulding cavity, and
- e) moulding elastomeric sole material to the bottom margin of the upper whilst simultaneously moulding the welt strip to form the edge of the sole.

The invention is clarified hereafter in connection with the accompanying drawings. In Fig. 1, in a cross section through the edge of the footwear while still in the mould, the upper 1 is first mounted loosely on the mould last 2. If the upper is made from leather, the

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invention provides that the upper is mulled, i.e. increased in humidity before placing it on the last. Usually, previously, the lasting margin 11 is provided with lasting means. In this embodiment of the invention, the use of peripheral string lasting 8 is preferred. The lasting string may be stitched to a reinforcement strip 7 which in turn is stitched at 6 to the bottom margin 11. Alternatively, the string last stitch may secure both the string and the bottom margin to the reinforcement strip. In either case the strip 7 prevents damage to the material of the upper

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even if it is of low tear strength while the lasting string is pulled tight. To prevent damage due to over-lasting, stops 9 are inserted in the last bottom plate 12. These stops may be a number of pins or a ridge at least in critical locations, such as the toe.

The last body 2 is heated by a heating element 3 or in any other way temperature controlled independent of the bottom plate 12, which is kept away from the last body by spacers 10, or is in any other way insulated. In this manner the upper 1 can be subjected to heat shrinking after the lasting, or heat setting, without heat transfer into the mould cavity. The reinforcing strip 7 might be used not only as stop along its inner edge during the lasting, but might also cover the upper surface of the sole rim and serve as sealing means for the sole mould cavity. If used as a welt in this manner, pins 5 in the side wall of the mould cavity are provided to locate and hold the welt during moulding. If the strip 7 is extended to form a wrapper, as shown at 17 in Fig. 3, it is preferred to inject the elastomer into the mould cavity so that the pressure of the moulding forces the wrapper 17 against the cavity walls, leaving just a narrow band of the elastomer exposed.

In other types of footwear, the reinforcing 7 might be a welt strip containing mouldable elastomer. As example, Fig. 2 shows an upper 1 to which a welt 7 is secured by the stitching 6. The welt consists in this example of closed cell porous rubber, already vulcanized, with a ribbon of unvulcanized rubber on its inner margin.

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The upper with the welt and a sole 36, of the same material as the welt, are placed into a vulcanizing mould with a filler 38. Under the influence of the heat and pressure in the mould, the ribbon of unvulcanized rubber, preferably containing blowing agents, will mould itself into the connective ribbon 37, not only uniting upper, welt, sole, and filler, but will at the same time create a stepless transition from the inner surface of the upper to the inner sole surface. For other types of footwear, the entire strip 7 might consist of mouldable elastomer, be it unvulcanized rubber or thermoplastic polymers.

To assure the correct location of the upper on the last, so important for good quality of the footwear, the invention provides deformations of the mould last not only on the last bottom plate by the locating means 9, but also pins or ridges 15 as shown in Fig. 1 for the instant correct location of the outer parts of the upper. Such deformations of the mould last are important for very soft and flexible uppers such as sandals.

In another execution of the invention, the strip 7, which might be formed by folding the margin of the upper and stitching through the fold, might be used to hold the upper in the mould cavity while allowing the last to move slightly away from the mould cavity so as to tighten the upper on the last while subjected to heat setting. The move of the last might be caused by outside forces or by the pressure of the moulding compound. In either case, the stringlasted upper without a structural insole will easily accept this combined stretching and

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heatsetting.

While the improvements described above already reduce the importance of the adjustments of the mould, the steady control by the operator cannot be neglected. For footwear with soles attached by injection moulding the invention provides that the side frame, a component of the mould cavity, is hingedly or otherwise connected to the mould last so that the operator can inspect the position of the shoe bottom after the side frame is closed in its final position in relation to the upper. On the commonly used turret type sole moulding machines, one or two mould lasts are mounted on each turret arm. The invention provides that for each last, its fitting side frame travels with it, and locating and locking means are provided. By using lasts differing from the other lasts, be it by being right or left, differing in size and/or width, it becomes possible to produce in a single machine cycle different pairs without any time loss for mould changes. By letting not only the side frame, but, also the bottom plate (piston) travel with the last, it becomes possible to attach to each turret arm a complete unit mould as shown in Fig. 3. Here the last 2 is secured to the last carrier 28 to which at 18 the side frame 4 is hinged. A hinge 20 allows to open the side frame for removal of the finished shoe from the mould. To secure the correct position of the side frame in relation to the last, the invention provides the locating posts 26, being divided and secured permanently to the last carrier and to the side frame respectively. After closing the side

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frame halves over the shoe bottom (closing means not shown) the locking means 27, such as excenters, are actuated and the bottom plate 22, hinged at 19 to the last carrier, can be moved into place and locked by means 29. As the adjustment of frame to last, or change of frame for a change in upper material, can be carried out off the machine by the use of such unit mould, and all machine adjustment is eliminated, substantial savings are obtained compared to the present method of manufacture where each turret serves a single mould even if the turret has three arms, all carrying identical lasts.

To reduce the need for changing side frames for variations in the upper, the invention provides that the side frame is further segmented, as shown in Fig. 4. Here the side frame halves 4 with the lip plates has a segment, at least the heel part segment 32 of the lip plate hinged at 31 and thereby movable in relation to the side frame 4. A spring 35 presses the lip plate resiliently against the upper material independently of the closing of the side frame halves. In this manner, undue pressure against the upper of heavier material or loss of contact with an upper of thinner material is eliminated. As often the so-called backstay, the rear seam of the upper is difficult to tighten to the last, a pressure pad 33 exerts the necessary pressure to smoothen this seam by the closing of the side frame. A guide surface 34 on the pressure pad 33 assists in the closing of the lip frame halves.

In many cases it is advisable also to segment

the bottom plate or piston into a rim segment and a centre segment. As shown in Fig. 3, a centre segment 24 for the spike insert 25 of a golf shoe is guided by the taper surfaces 23 into the correct position during the closing of the mould even if before the segment was placed incorrectly or tended to move under the influence of the moulding pressure. Fig. 3 shows also the heel breast insert 21 which is divided and each half secured to a half of the side frame 4. This allows the undercut of the heel breast as the segments 21 swing sideways with the opening of the side frame.

If the mould piston is divided as shown in Fig. 1 into a rim segment and a centre segment, the centre segment 14 might first be advanced towards the shoe bottom to flatten and hold the welt until the outer rim of the sole between rim segment 13 and welt is moulded. Thereafter the segment 14 might be withdrawn to the level of the rim and a sole centre of the same or different sole material can be moulded. The sequence can also be reversed, i.e. the welt might be flattened first by the segment 13 while the segment 14 is spaced from the shoe bottom to mould an inner sole. By withdrawing both segments thereafter to the level of the total sole thickness, a sole shell including rim and tread sole is then moulded.

The moulding pressure exerted in moulding elastomeric soles to weltless uppers tends to decrease the sealing pressure, with various and obvious drawbacks. The invention eliminates these drawbacks by still another



deformation of the mould last, this deformation to allow a deflection of the upper as shown in Fig. 1 for the sealing of the foxing 36 to be moulded to the upper 1. The groove 37 in the last together with the edge 38 or nose of the side frame 4 causes such deflection that the sealing occurs along an essentially vertical or undercut surface, so that even the slightest movement away from the side frame and mould cavity does not as before decrease, but now increases the sealing pressure.

When the strip 7 is used for sealing the mould cavity, it is advisable to provide a prefinished welt of sufficient compression strength so that its position between the deformation of the sole plate of the last and the side wall of the mould cavity assures sealing contact. If the welt is extended to cover the side surface of the sole it is preferred to inlay its edge in the elastomeric material so as to eliminate the need for trimming after the moulding. The strip might also be perforated and/or its edge scalloped to create an inlay pattern in the sole edge.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A method of manufacturing footwear such as boots and shoes comprising the steps of:
  - a) providing an upper with a lasting string and a welt strip at its bottom margin,
  - b) placing said upper onto a mould last and tightening said upper thereon to last the upper thereto,
  - c) placing the lip of a side frame of the mould against the lasted upper and locking the side frame in that position,
  - d) moving the upper and a sole moulding cavity means into juxtaposition to close the sole moulding cavity, and
  - e) moulding elastomeric sole material to the bottom margin of the upper whilst simultaneously moulding the welt strip to form the edge of the sole.
2. A method according to claim 1 and including the step of temporarily moving a portion of the upper disposed in the mould cavity by means of contact between a nose on the side frame and the upper to enhance the sealing between the upper and the side frame.
3. A method according to either of the preceding claims, wherein the mould last includes a last body and a sole plate, the last body having heating means for heat setting the lasted upper and the sole plate having no such heating means so as to avoid heating the bottom margin of

the upper.

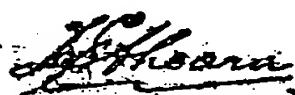
4. A method according to any one of the preceding claims wherein the step of locking the side frame is independent of the step of closing the cavity.
5. A method according to any one of the preceding claims, wherein following the locking of the side frame, additional lasting pressure is exerted through movement of the mould cavity means against the upper.
6. A method according to any one of the preceding claims, wherein the rim of the sole is moulded separately from the centre part of the sole.
7. A method according to any one of the preceding claims, including the provision of a conveyerised multi-last sole moulding machine, the conveyer of the lasts carrying the uppers and locked thereto the lip of the side frame being moved independently of but in co-ordination with the mould cavity means to bring each upper and its cavity means into said juxtaposition.
8. A last for carrying out the method claimed in claim 2, having a recess arranged to face the lip of the sole moulding cavity.
9. A last for carrying out the method as claimed in claim 3, having a heated body and an un-heated sole plate.
10. A mould for carrying out the method as claimed in claim 4, comprising a last and a mould cavity means wherein the frame carrying the cavity sealing lip can be placed and locked against the upper on the last, characterised in that the lip locking means are connected to the last and are independent of the mould cavity means.

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11. A mould for carrying out the method as claimed in claim 5, wherein segments of the side frame carrying the lip at the toe or heel are movable in relation to the shank sections or segments of the side frame.
12. A mould for carrying out the method as claimed in claim 6, wherein the bottom plate of the sole moulding cavity comprises a rim portion surrounding a centre portion, each of said portions being movable relative to the other.
13. A multiple last sole moulding machine for carrying out the method of claim 7, comprising a conveyer carrying only lasts and lockable side frames, and independent means to match each last with a sole moulding cavity means to close each mould cavity.
14. An article of footwear such as shoes, boots and the like manufactured in accordance with claims 1 to 7.

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